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THE ANALYSIS OF RESIN AND FATTY ACIDS IN THERMOMECHANICAL PULP MILL EFFLUENTS

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ABSTRACT

In co-operation with other Ministry Branches, a preliminary investigation was conducted aimed at determining the potential for fresh water contamination by effluents from the recently introduced thermomechanical pulping process at the Spruce Falls Power and Paper Company at Kapuskasing. For this project, the required analytical methodology was developed for the identification, separation and quantitation of toxic resin and fatty acids in these effluents at the ppb level. Process waters and effluents were surveyed for these contaminants and these data are now available for correlation with results from toxicity studies and current pulp mill production rates.

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INTRODUCTION AND OBJECTIVES

Pulp and paper mill effluents have been subject of concern for their capacity to contaminate rivers and lakes resulting in oxygen depletion, toxicity to aquatic life and production of odour and taste problems in these waters and associated fresh water supplies. Toxic contaminants in these effluents originate from the resin and lignin components of wood and their degradation products as well as from the chemicals presently used in various processes in the pulp and paper industry.

One process which is rapidly becoming wide-spread in this industry is the thermomechanical pulping (TMP) process as opposed to the chemical refining processes. The TMP process is based upon the use of steam instead of chemical treatment with sulphite, chlorine and/or chlorine dioxide for the removal of certain non-cellulosic components of wood. The Spruce Falls Power and Paper Company at Kapuskasing, which is operating the first TMP mill in Ontario, has been selected for a study of the effect on contamination to the adjacent Kapuskasing river from effluents of this new pulping process. Such study should prove of great general interest since the TMP process not only results in high-quality cellulose products at reduced manpower requirements, but also represents a cleaner process with respect to contaminants in its plant effluents. Furthermore, emissions of gaseous pollutants into the atmosphere are in contrast to conventional chemical processes negligible.

This study which was primarily aimed at the preliminary exploration of the chemical and toxicological aspects of the TMP-process in its aquatic environment, was carried out in co-operation with technical staff of the Northeastern Region, the Limnology and Toxicity Section of the Water Resources Branch and personnel of the pulping mill concerned.

In addition, representatives of the Environmental Protection Services of the Federal Government were acting in observing or advisory capacities. The Organic Trace Contaminants Section was charged with carrying out the necessary organo-analytical work which included development of suitable analytical methodology and the analyses of toxic organic acid components in samples of TMP process waters and plant effluents.

Waste products from the pulping industry which are commonly discharged into adjacent fresh water systems contain a number of resin acids, such as abietic acid, dehydro abietic acid, pimaric acid and related acids, which are well known for their toxicity to fish and other aquatic life. Other organic acids (aliphatic as well as aromatic acids) may also add to the toxicity in these waters which in the case of the TMP process under study is the Kapuskasing river. Thus, the main objectives for the analytical part of the study were the detection, identification and, as far as possible, quantitation of the organic acid components in samples from the TMP process. As a pre-requisite, it was necessary to establish analytical procedures by which these chemically closely related compounds could be separated from each other (and from any other interfering compounds) in order to permit determination of these acids at the low ppb-level at which they were expected to be present in these samples.

In an Interim Report (OTC-7712) on this project, data from resin and fatty acid analyses in TMP effluent samples had been reported as were then available. In the initial stage of the analytical work, the first series of samples (see Tables 1A, 1B, 2A, 2B) had been used for establishing sampling procedures (including sample preservation by pH-adjustment) and for developing suitable analytical procedures to the point where separation and tentative identification

of trace organic acids could be carried out on a routine basis and where quantitation of these acids appeared to be reasonably reproducible.

The analytical results from several series of the submitted samples in this survey had already been included in the Interim Report. The results of the analyses of all samples as well as the detailed description of each step of the analytical method used in the survey are now reported.

ANALYTICAL

A. Principle of Analytical Method

The weakly acidified (pH3) aqueous samples from TMP process effluents are extracted with diethyl ether. The ether extract containing the resin and fatty acids is separated, dried and concentrated to small volume. By reaction with diazomethane, these organic acids are converted to the corresponding methyl esters. By gas chromatography with the use of a flame ionization detector and with temperature programming, the methyl esters are separated on a column of SP216 on Supelcoport. By relating the peak heights of the esters on the gas chromatogram to those of known standards, quantitative estimation of the organic acid components in the original samples is possible even at the ppb level.

B. Range and Sensitivity

The lower detection limit for the measurement of resin acids is 0.05 mg/litre and for fatty acids 0.02 mg/liter. There are no upper limit problems when measuring concentrations of these acids in aqueous process effluents.

C. Interferences and Limitations

Extraction efficiencies for the resin and fatty acids were found in recovery experiments with standard solutions to be between 88% and 95%. In this preliminary work, the analytical results are reported as obtained, without adjustment to these minor losses.

In the gas chromatographic analysis, certain phenolic compounds may elute at similar retention times as the fatty acid esters. In the samples investigated, these phenolic compounds appeared to be present at much lower concentrations so that interferences with the fatty acid analyses was regarded as insignificant.

It should be noted that in this exploratory work, identification of the fatty and resin acids was by gas chromatographic retention time only and, therefore, should be regarded as tentative.

D. Procedure

1. Sample Pretreatment and Extraction

The aqueous samples of about 500 ml, as taken at the sampling points, are routinely adjusted to pH3 with concentrated hydrochloric acid. This treatment serves to preserve the samples from bacterial degradation and to ensure uniformity in the subsequent ether extraction of the organic acids.

The extraction procedure involves the following steps:

a. Measure volume of sample (in ml) in a graduate cylinder and transfer the acidified sample into a 1000 ml separatory funnel.

b. Add 100 ml of glass-distilled diethyl ether and shake 2 minutes. Then allow mixture to settle.

c. Drain lower, aqueous portion into the original sample bottle. Then collect top layer of mixture in a 500 ml Erlenmeyer flask.

d. Repeat the extraction procedure with another 50 ml portion of glass-distilled diethyl ether.

e. Rinse sample bottle with 30 ml of diethyl ether and pour into the separatory funnel.

f. Drain lower layer of mixture and discard. Collect top layer in the same Erlenmeyer flask.

g. Rinse walls of separatory funnel twice with 20 ml portions of diethyl ether and transfer to the Erlenmeyer flask.

h. Add approximately 8 gm of anhydrous magnesium sulphate to the ether extract in the Erlenmeyer flask and shake intermittently for about 10 minutes to dry the extract.

i. Pass the ether extract through a glass fibre filter into a 300 ml round bottom flask.

j. Rinse walls of Erlenmeyer flask twice with portions of anhydrous diethyl ether and collect in the round bottom flask.

k. Concentrate extract in the round bottom flask to about 1 ml volume by using a rotary evaporator with a water-bath at room temperature.

Stopper the flask and retain the 1 ml concentrate for the methylation procedure (see 2 b).

2. Esterification with Diazomethane

a. Preparation of Diazomethane

CAUTION: Diazomethane is very toxic and may explode on heating or when concentrated from solutions. Use a fume hood, safety shield and safety glasses. Use "Teflon" sleeves in ground glass joints of glass apparatus.

Since diazomethane is not commercially available, it is prepared in the laboratory from intermediate compounds, such as p-tolylsulphonylmethylnitrosamide.

Into a 250 ml long-necked Claison distilling flask, provided with a dropping funnel and an efficient downward condenser, place a solution of 12 g of potassium hydroxide in 20 ml water, followed by 70 ml of carbitol (diethyleneglycol monoethyl ether) and 20 ml of diethyl ether. Connect the condenser to a 100 ml round-bottom flask and a 100 ml conical flask, in series, containing 20 and 45 ml of diethyl ether respectively. While these flasks are cooled in an ice-salt bath, the mixture in the Claison distilling flask is heated on a water-bath at about 70°C with constant stirring by means of a magnetic bar and stirrer.

As soon as the ether commences to distil, add a solution of 43 gm p-tolylsulphonylmethylnitrosamide in 250 ml of diethyl ether through the dropping funnel and distil until the distillate is colourless.

The ethereal solution in the round-bottom flask contains about 6 gm of diazomethane. Replace the distilling flask with the round-bottom flask containing the diazomethane solution, and re-distil the diazomethane. The resulting ethereal solution of diazomethane can be stored in the freezer (at about -28°C) if not immediately used.

b. Methylation with Diazomethane

i. Add 1.5 ml of the diazomethane solution slowly to the round-bottom flask containing the 1 ml concentrate of the ether extract of the sample (see 1k) while being cooled in an ice bath. During this operation, the initial gas evolution ceases and the reaction mixture assumes a pale yellow colour.

ii. Transfer the content of the flask to a 20 ml graduated conical glass tube.

iii. Rinse the walls of the flask twice with several ml of diethyl ether and add to the conical glass tube.

iv. Concentrate the content in the conical glass tube to exactly 1.0 ml volume by blowing down in a stream of nitrogen in a water-bath at room temperature.

v. Use 5 ul aliquots for injection into the gas chromatograph (see D3).

3. Gas Chromatographic Analysis

The concentrated extract of the original water sample, containing the methylated organic acid contaminants, is subjected to gas chromatography at conditions as follows:

Instrument - Gas chromatograph equipped with flame ionization detector (FID) and with temperature programming facility. E.g. Varian Aerograph Model 2700.

Column - 6 ft. x 1/8 in. I.D.; stainless steel; 10% SP216 on Supelcoport; 100/120 mesh.

Column Temperature - 80°C to 185°C programmed at 15°C/min.

Detector Temperature - 300°C

Injector Temperature - 300°C

Carrier Gas - Nitrogen, flow rate 35 ml/min.

Hydrogen - Flow rate 35 ml/min.

Air - Flow rate 180 ml/min.

Chart Speed - 0.25 in./min.

Injection Volume - 5 ul.

The gas chromatograms of methylated fatty and resin acids in a standard solution as well as obtained from an effluent sample (Chip Washer Water) are shown in Figures 1 and 2.

FIGURE 1

GAS CHROMATOGRAM: FATTY AND RESIN ACIDS IN "STANDARD SOLUTION"

(AS METHYL ESTERS)

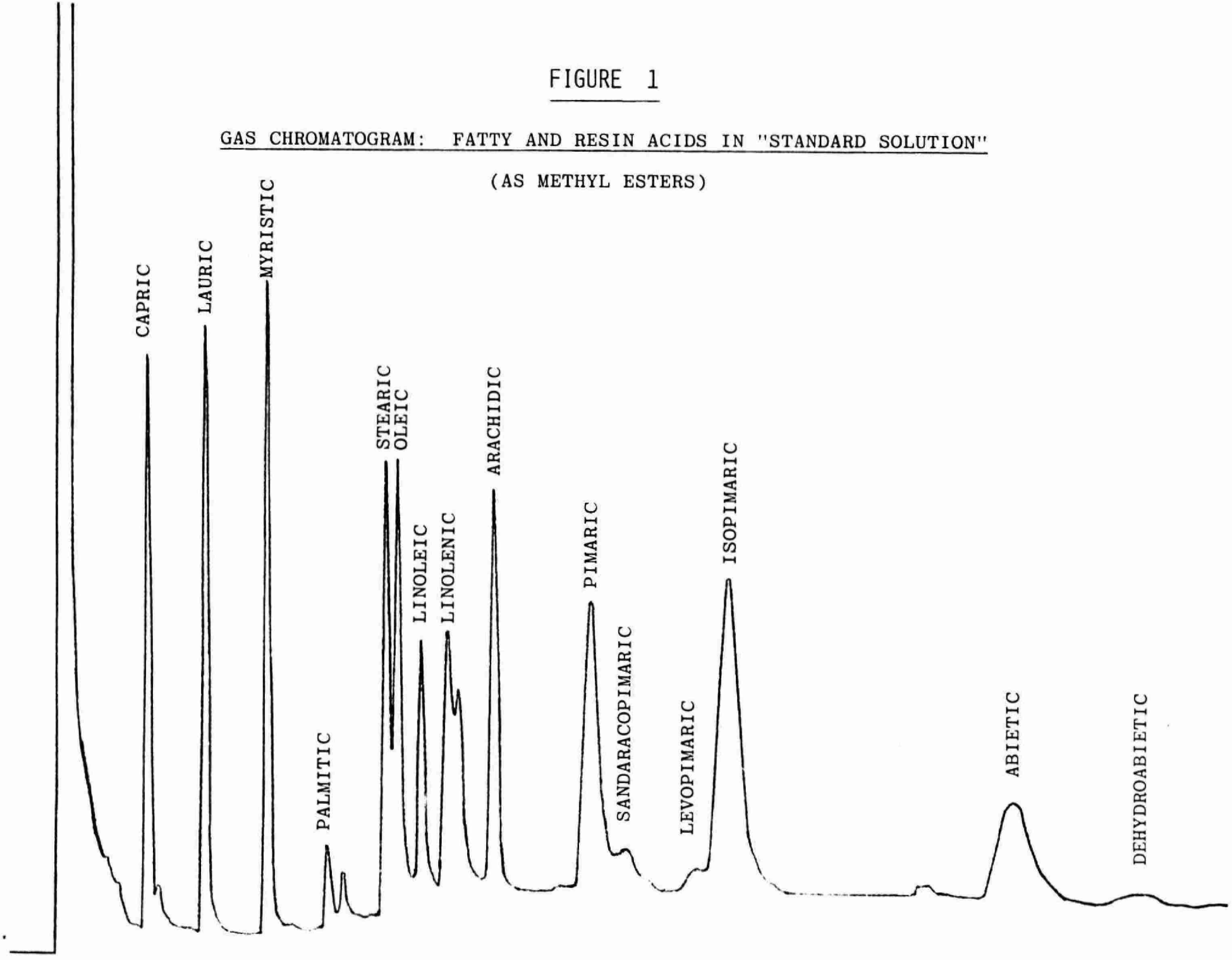
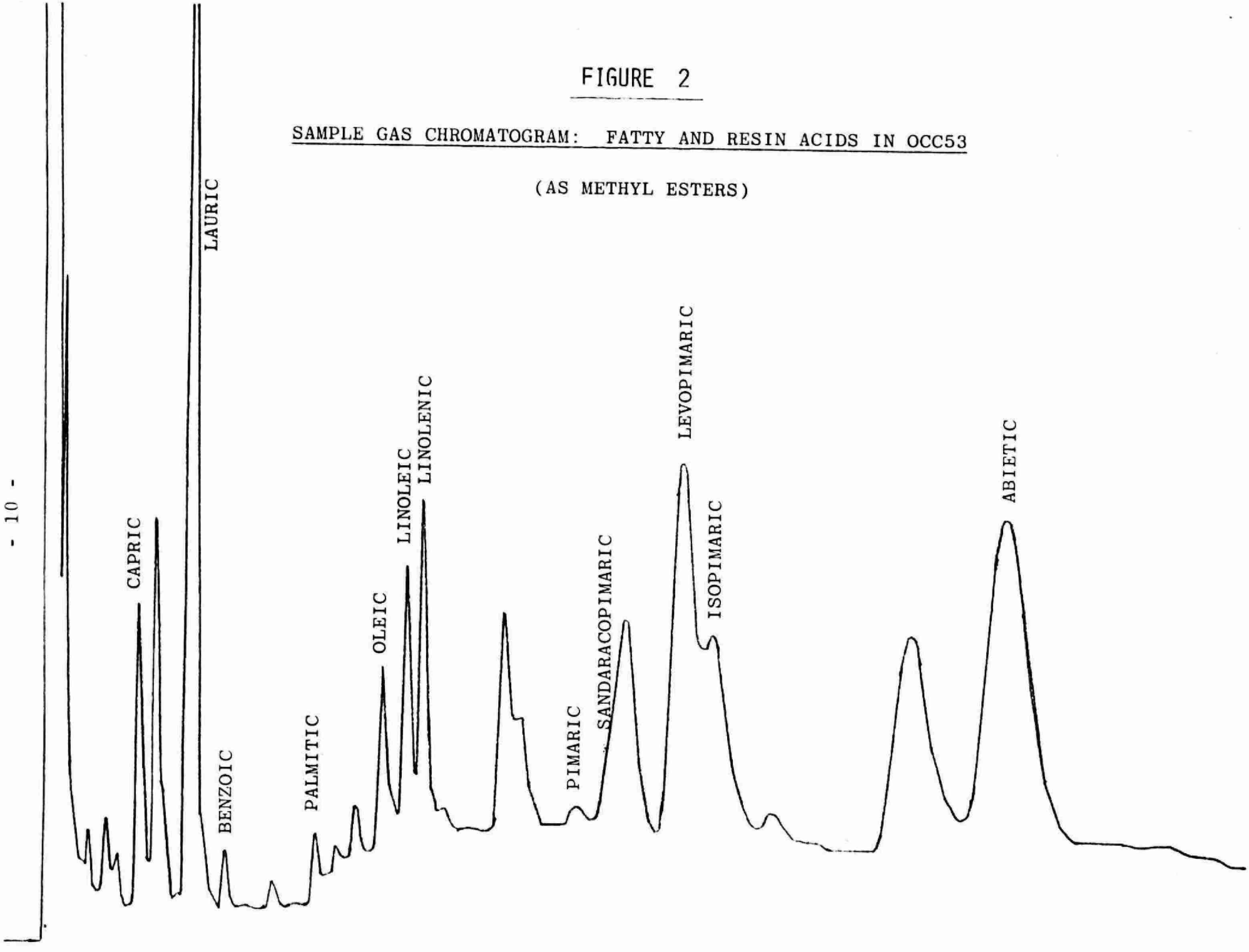


FIGURE 2

SAMPLE GAS CHROMATOGRAM: FATTY AND RESIN ACIDS IN OCC53

(AS METHYL ESTERS)



4. Organic Acid Standards

a. Reagents Used

The following organic acids were used in the preparation of standard solutions:

i. Resin Acids:

Pimaric Acid, $C_{20}H_{30}O_2$;
M.W.302

Sandaracopimaric Acid,
$C_{20}H_{30}O_2$;
M.W.302

Levopimaric Acid,
$C_{20}H_{30}O_2$;
M.W.302

Isopimaric Acid;
$C_{20}H_{30}O_2$;
M.W.302

Abietic Acid, $C_{20}H_{30}O_2$;
M.W.302

Dehydroabietic Acid,
$C_{20}H_{28}O_2$;
M.W.300

ii. Fatty Acids:

Caproic Acid, $CH_3-(CH_2)_4-COOH$; M.W.116

Capric Acid, $CH_3-(CH_2)_8-COOH$; M.W.172

Lauric Acid, $CH_3-(CH_2)_{10}-COOH$; M.W.200

Myristic Aicd, $CH_5-(CH_2)_{12}-COOH$; M.W.228

Palmitic Acid, $CH_3-(CH_2)_{14}-COOH$; M.W.256

Stearic Acid, $CH_3-(CH_2)_{16}-COOH$; M.W.284

Oleic Acid, $CH_3-(CH_2)_7-CH=CH-(CH_2)_7-COOH$; M.W.282

Linoleic Acid, $CH_3-(CH_2)_4-CH=CH-CH_2-CH=CH-(CH_2)_7-COOH$: M.W.280.

Linolenic Acid, $CH_3-(CH_2-CH=CH)_3-(CH_2)_7-COOH$; M.W.278.

Ricinoleic Acid, $CH_3-(CH_2)_5-CHOH-CH_2-CH=CH-(CH_2)_7-COOH$; M.W.298.

Arachidic Acid, $CH_3-(CH_2)_{18}-COOH$; M.W.313.

iii. Aromatic Acids:

Benzoic Acid, $C_7H_6O_2$; M.W.122

Salicylic Acid, $C_7H_6O_3$; M.W.138

iv. Other Reagents Used in Analytical Method:

Hydrochloric Acid, concentrated; Reagent grade
Sodium Hydroxide, pellets; Reagent grade.
Potassium Hydroxide, pellets; Reagent grade.
Diethyl Ether, anhydrous; glass-distilled.
Magnesium Sulphate, anhydrous; Reagent grade.
Carbitol (diethyleneglycol monoethyl ether); re-distilled.
p-Tolylsulphonlymethylnitrosamide; C.P.
Glass Fiber Filter Paper; Grade 934AH Reeve Angel by Whatman Inc.

b. Preparation of Stock Solution

Stock solutions are made up from each fatty acid, at 5000 ppm (wt/v) concentrations, by transferring 250 mg of the respective fatty acid into a 50 ml volumetric flask, adding diethyl ether to dissolve the acid and subsequently making up to volume with diethyl ether.

Stock solutions are made up from each resin acid, at 10,000 ppm (wt/v) concentrations, by transferring 500 mg of the respective resin acid into a 50 ml volumetric flask, adding diethyl ether to dissolve the acid and subsequently making up to volume with diethyl ether.

These stock solutions are kept in stoppered flasks in the freezer until used for standardization.

c. Preparation of Standard Solutions

A "Working Standard", containing all of the fatty and resin acids, is prepared immediately before use by transferring exactly 4.00 ml of each of the above stock solutions of fatty and resin acids into a 100 ml volumetric flask and then making up to volume with diethyl ether. This "Working Standard" contains 20 mg of each fatty acid and 40 mg of each resin acid in 100 ml ethereal solution, i.e. 200 ppm (wt/v) and 400 ppm (wt/v), respectively.

A "Standard Solution" is prepared by transferring exactly 1.0 ml of the "Working Solution" into a 15 ml calibrated conical glass tube and subjecting it to methylation by addition of the ethereal solution of diazomethane under the conditions described in 2b. The reaction mixture, blown down to exactly 1.0 ml volume, contains the fatty and resin acids, as their methyl esters, in quantities of 0.2 mg and 0.4 mg, respectively. Aliquots of 5 ul are taken from this "Standard Solution" with a syringe for injection into the gas chromatograph.

d. Calculation

The fatty and resin acid concentrations in the aqueous samples are calculated by relating the respective gas chromatographic peak heights with those obtained from the "Standard Solution":

$$Y = \frac{X \cdot m \cdot 1000}{S \cdot v}, \quad \text{where}$$

Y = Concentration (ppm) of fatty or resin acid in sample.

X = Peak height of fatty or resin acid in sample.

S = Peak height of fatty or resin acid in "Standard Solution".

m = Fatty or resin acid (mg) in 1 ml of"Standard Solution".

v = Volume of aqueous sample (ml) used in analysis.

5. Recovery Tests

The extraction efficiency and the losses incurred during the concentration procedures of the analytical method were investigated by carrying out recovery tests on "synthetic" aqueous samples containing known amounts of fatty and resin acids.

A "synthetic" sample is prepared as follows: Exactly 2.50 ml of the Working Standard (4c), which contains each of the fatty acids and each of the resin acids at 200 ppm (wt/v) and 400 ppm (wt/v), respectively, is transferred into a 500 ml volumetric flask. After the addition of about 200 ml tap water, the small amount of diethyl ether on the surface is evaporated by passing a stream of nitrogen gas into the flask. The aqueous solution is adjusted to pH3 with concentrated hydrochloric acid and then made up to volume with tap water. The resulting "synthetic" sample of 500 ml, containing each of the fatty acids at 1 ppm (wt/v) concentration and each of the resin acids at 2 ppm (wt/v) concentration, is then subjected to exactly the same sequence of procedures as described in D1 to D3 for the analytical method.

The resulting gas chromatographic peaks obtained from this "synthetic" sample are then directly compared with the corresponding peaks obtained from the methylation product of exactly 2.50 ml undiluted organic acid mixture of the Working Standard. The percent recovery of each fatty and resin acid by the extraction procedure is calculated as follows:

$$Z = \frac{X \cdot 100}{Y}, \text{ where}$$

Z = Percent recovery of fatty or resin acid

X = Peak height of fatty or resin acid in "synthetic" sample.

Y = Peak height of fatty or resin acid in "Working Standard" (starting material)

The analytical results from three independent recovery tests are shown in Table 1. They indicate that reasonably high extraction efficiencies of 87% to 97% have been achieved under the conditions of the analytical method for all fatty and resin acids investigated.

TABLE 1

RECOVERIES OF FATTY AND RESIN ACID STANDARDS BY ANALYTICAL METHOD

Organic Acid	Recovery, %	Mean, %
Capric	93	
	88	91
	93	
Lauric	94	
	94	94
	94	
Myristic	92	
	95	94
	95	
Palmitic	91	
	95	93
	94	
Stearic	93	
	97	95
	94	
Oleic	94	
	96	94
	93	
Linoleic	88	
	93	90
	88	
Linolenic	88	
	88	90
	94	

TABLE 1 (Cont'd)

Organic Acid	Recovery, %	Mean, %
Arachidic	89	
	90	89
	87	
Isopimaric	94	
	94	92
	88	
Abietic	88	
	90	88
	87	

SURVEY

1. Samples From E. B. Eddy Company

For the purpose of testing the analytical method for resin and fatty acids, as it was being developed, aqueous process samples from the E. B. Eddy Company, Espanola, had been analyzed before the samples from the TMP process at Kapuskasing became available. See Tables 1A to 3B and 6A, 6B.. These analyses were also intended to serve for a comparison of contaminants levels from a conventional chemical pulping process with those from the new TMP process.

In this earlier work, recovery tests on standards of resin and fatty acids were carried out by using the same preservation technique (pH-adjustment) as was used for the samples at the E. B. Eddy Company. These recovery tests indicated that losses of over 50% of these acids had occurred under those conditions.

The standards, prepared from organic acids at comparable low concentrations, had been adjusted to pH 9 with 50% aqueous alkali in the same way as initially the samples from E. B. Eddy Company had been adjusted in the field, before they were subjected to the same analytical steps as all other samples.

Apparently it was this alkali treatment, followed by acidification with concentrated hydrochloric acid prior to the extraction of the organic acids, which was the main cause of losses or deterioration of these acids. This was confirmed by using standard solutions which, by omitting the alkali treatment, had been directly acidified to pH 3, and where-upon recoveries of resin and fatty acids increased to the high levels shown in Table 1. The purpose of this alkali treatment had been to preserve the samples and prevent deterioration of the organic acids. But it was shown by the analyses of all subsequent samples (Tables 3A to 8B) that the same effect could be achieved by adjustment to pH3.

With the start of sampling at the Spruce Falls P. & P. Mill in Kapuskasing, all samples were directly (at the source) acidified to pH3 and, thus, any alkali treatment had been avoided. The results shown in these Tables have not been corrected for possible losses during the analytical work-up procedures since these analyses were essentially exploratory, and were aimed primarily at giving an indication as to the nature and relative amounts of these acid contaminants in the samples. Therefore, the values shown in these Tables could be assumed to be about 10% lower than the actual concentrations in the samples may have been.

Comparison of results from the analyses of these samples with those obtained from the samples of E. B. Eddy

Company shows, generally, elevated levels for fatty acids in the Kapuskasing samples and as much as two orders of magnitude higher levels for the toxic abietic acid. However, the volumes of the process and effluent streams, from which the samples had been taken, and certain other considerations must be taken into account before an assessment or comparable evaluation of these pulp mill processes can be made.

2. Samples From Spruce Falls Power & Paper Co., Kapuskasing

The samples submitted from the TMP process at Kapuskasing had been collected during the period April 26, 1977 to June 15, 1977. In this period, the process had been operated with dark spruce as the exclusive feed stock.

The process waters or effluents which had been sampled for monitoring the concentration levels of resin and fatty acids are listed below. The analytical results are shown in Tables 4A to 5B and 7A to 10B.

a. Process Warm Water:

Contains condensate water from TMP process steam. Sample analyses showed resin acid and fatty acid contaminants either below their detection limits (0.05 mg/l and 0.02 mg/l, respectively) or in trace quantities only (below 1 mg/l). The levels for these contaminants are considered to be negligible.

b. Chip Washer Effluent:

Accounts for a major portion (22-24%) of the total dissolved solids discharge from the TMP process. The total of 6 resin acids analyzed (in sample OCC-53) was found to be as high as 182 mg/l.

Abietic acid alone amounted to 105 mg/l. In addition, at least one major peak on the gas chromatogram is believed to originate from a further, as yet unidentified, resin acid which could increase the total resin acids toward the 250 mg/l level. Other resin acids found at high concentrations were levopimaric acid (71 mg/l) and isopimaric acid (4.5 mg/l). Moderate to low levels of the remaining resin acids analyzed in samples of Chip Washer Effluent were found to average 11.9 mg/l dehydroabietic acid, 1.4 mg/l sandaraco-pimaric acid, and 1.1 mg/l pimaric acid.

The 9 fatty acids analyzed in sample OCC-53 reached a total concentration of 37.4 mg/l. Lauric acid alone accounted for 32.3 mg/l in this effluent sample. It should be pointed out, however, that due to the small difference in gas chromatographic retention times of lauric acid and benzoic acid, this latter acid may have been mistaken for lauric acid. Other fatty acids found in Chip Water Effluent at moderately high levels included arachidic acid averaging 5.0 mg/l; linoleic acid 3.6 mg/l; oleic acid 1.2 mg/l; capric and palmitic acids each 0.8 mg/l.

c. Fourth Stage Cleaner Rejects:

Contains at the point of discharge the organic contaminants in a concentrated form. The 6 resin acids analyzed in sample OCC-57 amounted to a total concentration of 56.4 mg/l. While abietic acid was present at 33.2 mg/l, an as yet unidentified resin acid was found at similar high concentration. This would bring the total resin acids concentration close to 90 mg/l and isopimaric acid at 1.1 mg/l.

The analysis of Fourth Stage Rejects samples showed that the average concentration for most of the nine fatty acids analyzed was near 1 mg/l.

d. TMP Stock Liquor (With Bleach Added):

The analysis of a sample from this process stream (OCC-64) indicated the presence of abietic acid and dehydroabietic acid in high concentrations (25.5 mg/l and 6.7 mg/l, respectively). The total concentration of the 6 resin acids analyzed was 35.6 mg/l. At least one unidentified resin acid in this sample would add substantially to the total resin acid concentration. The fatty acid concentration totalled only 2.4 mg/l, with linoleic acid, at 1.4 mg/l, being the major component in this sample. Other samples taken from the TMP Stock Liquor showed similar composition in resin and fatty acids.

CONCLUSIONS AND RECOMMENDATIONS

1. An analytical method was developed for the separation and quantitative determination of resin and fatty acids at the ppb level. By this method, 6 resin acids and 9 fatty acids were tentatively identified and quantitated in a preliminary survey of TMP process waters. Confirmation of the identity of these compounds by mass-spectrometry is presently under investigation.

2. Comparison of organic and contaminant levels in TMP process effluents with those from conventional chemical pulping processes indicated that the TMP process generates effluents with, generally, much higher concentrations of organic acids and, particularly, those of the toxic resin acids.

In accordance with the original planning of this project, the data produced in this work is now ready for correlation with data from toxicology studies, other chemical investigations (BOD, COD, total solids, etc.), and corresponding company data, such as relevent production rates, process water volumes and mill capacity used.

3. For the next phase of the survey work on the TMP process, as being planned for the budget year 1978/79, further analytical development and refinement of the methods used would appear desirable. Work on a more efficient extraction procedure with the use of microreticular adsorbents is already in progress and is showing promising results. Special efforts should be made to procure for reference and calibration purposes, resin acids and related degradation products which are commercially not available, by contacting pulp and paper research institutions and University laboratories. Further improved gas chromatographic separation and the use of mass-spectrometry could lead to a wide variety of toxic organic contaminants being identified and analyzed in process effluents.

TABLE 1A

COMPANY E. B. Eddy LOCATION Espanola

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO-PIMARIC A.	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC1	1	30/3	Service Water	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
OCC2	2	30/3	#1 Bleach Plant	Trace	Trace	Trace	Trace	Trace	Trace	
OCC3	3	30/3	#2 Bleach Plant	Trace	0.49	0.22	0.11	Trace	Trace	
OCC4	4	30/3	Total Mill Effluent	0.14	0.63	Trace	0.30	0.58	Trace	
OCC5	5	6/4	Total Mill Effluent (Duplicate Sample)	Trace	0.73	Trace	0.21	0.85	Trace	
Recovery tests of resin acid on 0.5 mg/liter standard for comparison.				45% ± 2	N.A.	N.A.	29% ± 2	44% ± 2	N.A.	
DETECTION LIMIT:				0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: N.D. = not detected. N.A. = not available.

All samples received were adjusted to pH approx. 9 (with aqueous 50% NaOH).

G.C. - Scans: Relatively poor resolution of peaks.

TABLE 1B

COMPANY E. B. EDDY LOCATION ESPANOLA

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	OLEIC A. STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	
OCC1	1	30/3	N.A.	N.D.	N.D.	N.A.	N.A.	N.D.	N.D.	N.D.	
OCC2	2	30/3	N.A.	0.10	0.06	N.A.	N.A.	0.08	0.08	0.04	
OCC3	3	30/3	N.A.	0.04	0.05	N.A.	N.A.	0.25	0.25	0.02	
OCC4	4	30/3	N.A.	0.04	0.06	N.A.	N.A.	0.11	0.11	0.03	
OCC5	1	6/4	N.A.	Trace	Trace	N.A.	N.A.	Trace	0.10	0.04	
DETECTION LIMIT:			N.A.	0.02	0.02	N.A.	N.A.	0.02	0.02	0.02	

FOOTNOTES: N.D. = not detected; N.A. = not available.

All samples received were adjusted to pH approx. 9 (with aqueous 50% NaOH)

G.C. - Scans: Relatively poor resolution of peaks.

TABLE 2A

COMPANY E. B. EDDY LOCATION ESPANOLA

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION TOTAL MILL EFFLUENT	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO-PIMARIC A.	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC-6	1	5/4	"Plastic Test Bucket"	0.12	0.37	Trace	0.13	0.24	Trace	
OCC-7	2	4/4	"Original Sample"	0.13	0.55	Trace	0.25	0.77	Trace	
OCC-8	3	6/4	"Glass Jar"	Trace	0.38	Trace	0.14	0.14	Trace	
OCC-9	4	6/4	"Plastic Pail"	Trace	0.36	Trace	0.12	0.12	Trace	
	Recovery tests of resin acid on 0.5 mg/liter standard for comparison.			45% ±2	N.A.	N.A.	29% ± 2	44% ± 2	N.A.	
	DETECTION LIMIT:			0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: All samples received were adjusted to pH approx. 9 (with aqueous 50% NaOH).

G. C. - Scans: Relatively poor resolution of peaks.

TABLE 2 B

COMPANY E. B. EDDY LOCATION ESPANOLA

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	OLEIC A. STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	
OCC6	1	5/4	N.A.	0.04	0.08	N.A.	N.A.	Trace	0.09	0.02	
OCC7	2	4/4	N.A.	0.04	0.11	N.A.	N.A.	0.02	0.04	0.02	
OCC8	3	6/4	N.A.	0.04	0.06	N.A.	N.A.	Trace	0.06	0.02	
OCC9	4	6/4	N.A.	0.04	0.07	N.A.	N.A.	Trace	0.07	0.02	
DETECTION LIMIT:			N.A.	0.02	0.02	N.A.	N.A.	0.02	0.02	0.02	

FOOTNOTES: N.A. = not available

All samples received were adjusted to pH approx. 9 (with aqueous 50% NaOH)

G.C. - Scans: Relatively poor resolution of peaks.

TABLE 3A

COMPANY E. B. Eddy LOCATION Espanola

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter					
				PIMARIC ACID	SANDARACO-PIMARIC A.	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.
OCC-12	1	20/4	#1 Bleach Plant	Trace	N.D.	N.D.	N.D.	0.13	0.17
OCC-13	2	20/4	#2 Bleach Plant	0.05	0.08	0.14	Trace	0.07	0.43
OCC-14	3	20/4	Total Mill Effluent Outfall Pond	0.42	0.10	0.52	0.19	1.70	0.45
OCC-15	4	20/4	Service Water - Power Canal	N.D.	N.D.	N.D.	Trace	Trace	Trace
	Recovery of Resin Acid on 0.5 mg/liter standard for comparison			N.A.	N.A.	N.A.	66% ± 4	84% ± 4	N.A.
	DETECTION LIMIT:			0.05	0.05	0.05	0.05	0.07	0.07

FOOTNOTES: N.D. = not detected; N.A. = not available

All samples received were adjusted to pH approx. 3 (with conc. HCl).

G. C. - Scans: Relatively poor resolution of peaks.

TABLE 3B

COMPANY E. B. EDDY LOCATION ESPANOLA

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	OLEIC A. STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	
OCC-12	1	20/4	0.53	0.22	0.09	N.A.	N.A.	0.11	0.07	0.08	
OCC-13	2	20/4	1.83	0.48	0.17	N.A.	N.A.	0.53	0.70	0.10	
OCC-14	3	20/4	0.50	0.21	0.12	N.A.	N.A.	0.88	0.11	0.17	
OCC-15	4	20/4	N.D.	N.D.	N.D.	N.A.	N.A.	N.D.	N.D.	N.D.	
Recovery of fatty acid on 0.5 mg/liter standard for comparison				92% ± 2	95% ± 0	N.A.	N.A.	54% ± 6	64% ± 8	88% ± 7	
DETECTION LIMIT:			0.02	0.02	0.02	N.A.	N.A.	0.02	0.02	0.02	

FOOTNOTES: N.D. = not detected; N.A. = not available

All samples received were adjusted to pH approx. 3 (with conc. HCl).

G. C. - Scans: Relatively poor resolution of peaks.

TABLE 4A

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO-PIMARIC A.	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC-16	77-14	26/4	TMP Warm Raw Water	Trace	Trace	Trace	0.06	0.09	N.D.	
OCC-17	77-15	26/4	TMP Drip Washer Rejects	0.74	1.89	6.37	3.18	93.05	29.20	
OCC-18	77-16	26/4	TMP Quat. Centricleaner Rejects	0.56	0.40	2.18	1.98	69.77	11.20	
OCC-19	77-17	26/4	TMP Stock Liquor (Rough Filtered)	0.33	0.32	1.23	1.07	32.33	10.67	
OCC-20	77-18	26/4	Ground Water Mill High Pressure Whitewater	0.33	0.25	0.80	1.11	30.53	6.28	
OCC-21	77-19	26/4	Ground Water Mill Low Pressure Whitewater	Trace	0.22	0.55	0.83	36.32	10.00	
OCC-22	77-20	26/4	Grinder Pulp (A)	Trace	0.24	0.99	0.79	19.32	1.90	
OCC-23	77-21	26/4	Grinder Pulp (B)	Trace	0.11	0.42	0.33	10.29	4.35	
DETECTION LIMIT:				— 0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: N.D. = not detected

All samples received were adjusted to pH approx. 3 (with conc. HCl).

G. C. - Scans: Good resolution of peaks.

TABLE 4B

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	OLEIC A. STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	
OCC-16	77-14	26/4	N.D.	N.D.	0.04	N.A.	O.P.	0.04	N.D.	N.D.	
OCC-17	77-15	26/4	1.68	5.58	0.16	N.A.	O.P.	1.57	1.24	5.96	
OCC-18	77-16	26/4	1.55	0.62	0.06	N.A.	O.P.	1.64	0.77	1.09	
OCC-19	77-17	26/4	0.86	0.50	Trace	N.A.	O.P.	1.33	0.60	0.97	
OCC-20	77-18	26/4	0.96	1.01	0.11	N.A.	O.P.	1.94	0.83	0.98	
OCC-21	77-19	26/4	1.52	0.85	0.10	N.A.	O.P.	0.39	1.13	1.04	
OCC-22	77-20	26/4	1.18	1.82	0.17	N.A.	O.P.	1.79	1.46	1.14	
OCC-23	77-21	26/4	1.11	1.39	0.14	N.A.	O.P.	0.96	0.69	0.63	
DETECTION LIMIT:			0.02	0.02	0.02	N.A.	N.A.	0.02	0.02	0.02	

FOOTNOTES: N.D. = not detected; N.A. = not available, O.P. = overlapping G.C. - peaks.
All samples received were adjusted to pH approx. 3 (with conc. HCl).
G.C. - Scans: Good resolution of peaks.

TABLE – 5A

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION GROUNDWOOD MILL	RESIN ACIDS, mg/liter					
				PIMARIC ACID	SANDARACO-PIMARIC A.	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.
OCC-28	77-5	18/5	Stock 1st sample, 11.45 p.m.	N.D.	0.15	N.D.	0.40	8.57	3.54
OCC-29	77-7	18/5	Stock Raw Water 1st sample, 11.45 p.m.	N.D.	0.07	N.D.	N.D.	N.D.	N.D.
OCC-30	77-9	18/5	Stock 2nd sample	N.D.	0.19	N.D.	0.33	11.49	3.98
OCC-31	77-21	18/5	Stock Raw Water, 2nd Sample	0.12	0.12	0.27	0.18	1.27	1.23
OCC-32	77-24	18/5	Stock Liquor	0.17	0.20	0.54	0.40	16.76	3.22
OCC-33	77-25	18/5	Stock Liquor	0.14	0.17	0.59	0.38	16.57	2.84
OCC-34	77-28	18-19/5	W W O/F 10.30	0.15	0.17	0.40	0.38	10.13	2.35
OCC-35	29	18-19/5	W W O/F 10.30	0.15	0.16	0.50	0.36	9.21	2.24
DETECTION LIMIT:				0.05	0.05	0.05	0.05	0.07	0.07

FOOTNOTES: N.D. = not detected

All samples received were adjusted to pH approx. 3 (with conc. HCl).

G. C. - Scans: Good resolution of peaks.

TABLE 5B

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	OLEIC A.
OCC-28	77-5	18/5	0.43	N.D.	0.10	0.22	0.24	0.65	0.14	N.D.	0.35
OCC-29	77-7	18/5	0.21	N.D.	Trace	0.15	N.D.	N.D.	N.D.	N.D.	N.D.
OCC-30	77-9	18/5	0.27	N.D.	0.11	0.14	0.20	0.44	0.11	N.D.	0.26
OCC-31	77-21	18/5	0.13	N.D.	Trace	0.06	0.08	0.31	0.07	N.D.	0.12
OCC-32	77-24	18/5	0.29	N.D.	Trace	0.19	0.12	0.56	0.09	N.D.	0.22
OCC-33	77-25	18/5	0.29	N.D.	Trace	0.16	0.10	0.54	0.08	N.D.	0.20
OCC-34	77-28	18-19/5	0.13	N.D.	Trace	0.16	0.09	0.64	0.08	N.D.	0.24
OCC-35	77-29	18-19/5	0.14	N.D.	Trace	0.15	0.09	0.62	0.08	N.D.	0.22
DETECTION LIMIT:			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

FOOTNOTES: N.D. = not detected

All samples received were adjusted to pH approx. 3 (with conc. HCl).

G.C. - Scans: Good resolution of peaks.

TABLE – 6A

COMPANY E. B. EDDY LOCATION ESPANOLA

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO ACID	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC 36	26	30/5	#1 Bleach	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
OCC 37	27	30/5	#2 Bleach	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
OCC 38	28	30/5	Power Dam	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	
OCC 39	29	30/5	Final Effluent	0.17	0.10	0.70	0.30	5.67	1.79	
DETECTION LIMIT:				0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: N.D. = not detected

All samples received were adjusted to pH approx. 3(with conc. HCl).

G. C.- Scans: Good resolution of peaks except for sample OCC-36.

TABLE 6B

COMPANY E. B. EDDY LOCATION ESPANOLA

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	OLEIC A.
OCC 36	26	30/5	0.16	N.D.	0.03	0.47	0.28	0.15	0.12	0.04	N.D.
OCC 37	27	30/5	0.41	N.D.	0.05	0.90	0.40	0.21	0.16	0.18	N.D.
OCC 38	28	30/5	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
OCC 39	29	30/5	0.21	N.D.	0.04	0.58	0.26	1.01	0.17	0.18	0.24
DETECTION LIMIT:			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

FOOTNOTES:

N.D. = not detected

All samples received were adjusted to pH approx. 3 (with conc. HCl).

G.C. - Scans: Good resolution of peaks except for sample OCC-36

TABLE – 7A

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO ACID	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC40	77-88	10:10 AM 14/6	CHIP WASHER WATER	0.87	1.32	N.A.	3.31	51.07	11.16	
OCC41	77-88 Duplicate	"	" " "	1.07	1.36	N.A.	6.01	90.30	7.89	
OCC42	77-91	10:15 AM 14/6	FOURTH STAGE REJECTS	0.51	0.97	3.71	1.57	32.74	2.76	
OCC43	77-91 Duplicate	"	" "	0.64	1.00	3.55	1.62	32.35	1.29	
OCC44	77-93	10:20AM 14/6	WARM WATER	N.D.	N.D.	N.D.	N.D.	0.11	Trace	
OCC45	77-93 Duplicate	"	" "	N.D.	Trace	N.D.	N.D.	Trace	Trace	
DETECTION LIMIT:				0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: ND = Not Detected. NA = Not Available

All samples received were adjusted to pH approx. 3 (with conc. HCl)

G.C. - Scan: Good resolution of peaks (except for levo-pimaric acids in some samples)

TABLE 7B

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	OLEIC ACID
OCC-40	77-88	10:10 AM 14/6	1.37	0.25	0.25	-	-	4.28	N.A.	6.18	-
OCC-41	77-88 Duplicate	"	N.A.	0.32	0.31	-	-	4.88	N.A.	4.89	-
OCC-42	77-91	10:15 AM 14/6	0.56	0.86	0.13	-	0.30	2.64	0.18	1.76	0.75
OCC-43	77-91 Duplicate	"	0.53	0.89	0.12	-	0.30	2.62	0.19	2.03	0.53
OCC-44	77-93	10:20 AM 14/6	N.D.	N.D.	N.D.	Trace	Trace	Trace	N.D.	N.D.	Trace
OCC-45	77-93 Duplicate	"	N.D.	N.D.	N.D.	Trace	Trace	Trace	N.D.	N.D.	Trace
DETECTION LIMIT:			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

FOOTNOTES: N.D. = Not Detected N.A. = Not Available

All samples received were adjusted to pH approx. 3 (with conc. HCl)

G.C. - Scan: Good resolution of peaks (except for some acids in samples OCC-40 and OCC-41)

TABLE 8A

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO ACID	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC-46	77-95	11:35 AM 14/6	CHIP WASHER WATER	N.A.	1.37	N.A.	5.07	87.57	11.02	
OCC-47	77-95 Duplicate	"	" " "	N.A.	1.14	N.A.	4.52	78.13	8.35	
OCC-48	77-99	11:35 AM 14/6	FOURTH STAGE REJECT	0.47	0.48	N.A.	0.62	29.64	Trace	
OCC-49	77-99 Duplicate	"	" " "	0.90	1.75	6.29	1.08	15.40	0.58	
OCC-50	77-102	11:45 AM 14/6	WARM WATER	N.D.	N.D.	Trace	Trace	Trace	Trace	
OCC-51	77-102 Duplicate	"	" "	N.D.	N.D.	Trace	Trace	Trace	Trace	
DETECTION LIMIT:				0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: N.D. = Not Detected N.A. = Not Available

All samples received were adjusted to pH approx. 3 (with conc. HCl)

G.C. - Scans: Good resolution of peaks (except for pimaric and levo-pimaric acids in some samples).

TABLE 8B

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	OLEIC ACID
OCC-46	77-95	11:35 AM 14/6	N.A.	N.A.	0.93	-	-	5.05	N.A.	4.19	-
OCC-47	77-95 Duplicate	"	N.A.	N.A.	0.41	-	-	4.34	N.A.	3.56	-
OCC-48	77-99	11:35 AM 14/6	Trace	N.D.	N.D.	-	0.30	1.93	0.07	1.43	0.38
OCC-49	77-99 Duplicate	"	Trace	N.D.	Trace	-	0167	Trace	Trace	0.48	0.61
OCC-50	77-102	11:45 AM 14/6	0.05	N.D.	0.03	Trace	Trace	0.05	N.D.	N.D.	Trace
OCC-51	77-102 Duplicate	"	0.10	N.D.	0.05	Trace	Trace	Trace	N.D.	N.D.	Trace
DETECTION LIMIT:			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

FOOTNOTES: N.D. = Not Detected N.A. = Not Available

All samples received were adjusted to pH approx. 3 (with conc. HCl)

G.C. Scans: Good resolution of peaks except for some acids in samples OCC-46 and OCC-47.

TABLE 9 A

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO-PIMARIC A.	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC-52	77-100	June 14	Warm Water 11:45 A.M.	N.D.	N.D.	N.D.	N.D.	Trace	N.D.	
OCC-53	77-104	"	Chip Washer Water 2:50 P.M.	1.16	N.A.	70.94	4.51	105.41	N.A.	
OCC-54	77-104	"	" (Duplicate)	1.69	N.A.	66.48	4.87	99.75	N.A.	
OCC-55	77-108	"	Warm Water 2:55 P.M.	N.D.	Trace	Trace	Trace	Trace	N.D.	
OCC-56	77-108	"	" (Duplicate)	N.D.	N.D.	0.17	Trace	0.07	N.D.	
OCC-57	77-110	"	4TH Stage Rejects 2:50 P.M.	0.35	N.A.	15.77	1.12	33.15	5.85	
OCC-58	77-110	"	" (Duplicate)	0.35	N.A.	8.45	1.07	36.09	N.A.	
DETECTION LIMIT:				0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: N.D. = Not Detected; N.A. = Not Available

All samples received were adjusted to pH approx. 3 (with conc. HCl)

G.C. - Scans: Good resolution of peaks (except for sandaraco-pimaric and dehydroabietic acids).

TABLE 9 B

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	OLEIC ACID
OCC-52	77-100	June 14	0.11	0.91	Trace	N.D.	N.D.	Trace	N.D.	N.D.	Trace
OCC-53	77-104	June 14	0.10	32.29	N.D.	0.88	N.D.	2.87	N.D.	N.D.	1.17
OCC-54	77-104	June 14	0.10	29.10	N.D.	0.81	N.D.	3.45	N.D.	N.D.	1.47
OCC-55	77-108	June 14	0.09	0.70	N.D.	Trace	N.D.	Trace	N.D.	N.D.	Trace
OCC-56	77-108	June 14	Trace	0.64	Trace	Trace	N.D.	Trace	Trace	N.D.	Trace
OCC-57	77-110	June 14	Trace	0.42	N.D.	0.88	N.D.	1.32	N.D.	N.D.	0.47
OCC-58	77-110	June 14	Trace	0.42	N.D.	0.83	N.D.	1.47	N.D.	N.D.	0.46
DETECTION LIMIT:			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

FOOTNOTES:

N.D. = Not Detected; N.A. = Not Available.

All samples received were adjusted to pH approx. 3 (with conc. HCl)

G.C. - Scans: Good resolution of peaks

TABLE 10 A

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	SAMPLE DESCRIPTION	RESIN ACIDS, mg/liter						
				PIMARIC ACID	SANDARACO-PIMARIC A.	LEVO-PIMARIC A.	ISO-PIMARIC A.	ABIETIC ACID	DEHYDRO-ABIETIC A.	
OCC-59	77-114	June 15	Warm Water 8:30 A.M.	Trace	N.D.	N.D.	N.D.	Trace	N.D.	
OCC-60	77-117	June 15	Chip Washer Water 8:30 A.M.	1.33	N.A.	10.56	2.53	58.15	3.67	
OCC-61	77-120	June 15	4TH Stage Reject 8:30 A.M.	0.22	0.90	7.38	1.04	30.54	3.86	
OCC-62	77-123	June 15	TMR Stock 1:15 P.M.	0.37	N.A.	1.56	0.79	23.26	Trace	
OCC-63	77-123	June 15	(Duplicate)	0.47	N.A.	2.21	0.85	25.68	Trace	
OCC-64	77-125	June 15	TMR Stock & Bleach 2:30 P.M.	0.37	0.49	1.67	0.87	25.52	6.69	
DETECTION LIMIT:				0.05	0.05	0.05	0.05	0.07	0.07	

FOOTNOTES: N.D. = Not Detected; N.A. = Not Available.

All samples received were adjusted to pH approx. 3 (with conc. HCl).

G.C. - Scans: Good resolution of peaks (except for sandaraco-pimaric A. and dehydroabietic acids).

TABLE 10 B

COMPANY SPRUCE FALLS P. & P. MILL LOCATION KAPUSKASING

LAB. NO.	SENDER'S NO.	SAMPLING DATE (1977)	FATTY ACIDS, mg/liter								
			CAPRIC ACID	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	STEARIC A.	LINOLEIC ACID	LINOLENIC ACID	ARACHIDIC ACID	OLEIC ACID
OCC-59	77-114	June 15	0.06	Trace	N.D.	N.D.	N.D.	Trace	Trace	N.D.	N.D.
OCC-60	77-117	June 15	Trace	2.94	N.D.	0.55	N.D.	2.16	N.D.	N.D.	0.97
OCC-61	77-120	June 15	N.D.	0.40	N.D.	0.86	Trace	1.43	N.D.	N.D.	0.45
OCC-62	77-123	June 15	N.D.	0.24	N.D.	0.21	N.D.	0.98	N.D.	N.D.	0.47
OCC-63	77-123	June 15	N.D.	0.25	N.D.	0.30	N.D.	0.85	N.D.	N.D.	0.41
OCC-64	77-125	June 15	N.D.	0.19	N.D.	0.24	N.D.	1.37	N.D.	N.D.	0.56
DETECTION LIMIT:			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

FOOTNOTES:

N.D. = Not Detected; N.A. = Not Available.

All samples received were adjusted to pH approx. 3 (with conc. HCl)

G.C. Scans: Good resolution of peaks